

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
19 July 2001 (19.07.2001)

PCT

(10) International Publication Number  
**WO 01/52531 A1**

(51) International Patent Classification<sup>7</sup>: H04N 5/77, 5/907, 13/00, G02B 13/18

(21) International Application Number: PCT/US00/00394

(22) International Filing Date: 7 January 2000 (07.01.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicants and

(72) Inventors: HAMMACK, Jack, C. [US/US]; 1715 - 114th Avenue S.E., Bellevue, WA 98004 (US). HAMMACK, Steven, R. [US/US]; 1280 Ocean Shores Boulevard S.W., Ocean Shores, WA 98569 (US).

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

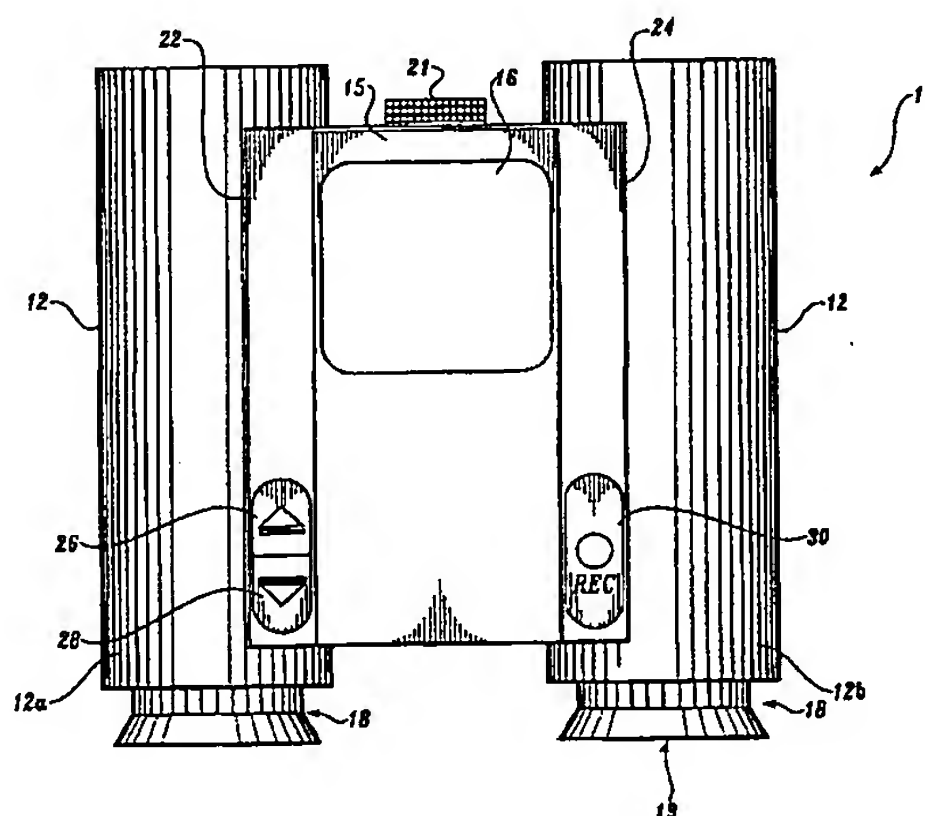
Published:

— with international search report

(74) Agent: HOPE, Leonard, J.; Christensen O'Connor Johnson & Kindness PLLC, Suite 2800, 1420 Fifth Avenue, Seattle, WA 98101 (US).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DIGITAL RECORD AND REPLAY BINOCULARS



(57) Abstract: A combined binocular viewing and digital recording device includes a binocular telescope wherein the binocular telescope includes a pair of monocular components (12a, b). Each monocular component (12a, b) has an image viewing end and an image receiving end. The monocular components (12a, b) include a focusing mechanism (18) to adjust images viewed through the image viewing end of the monocular components. Also, the device includes a digital video camera (15) mounted to and displaced between each monocular component. The camera includes a receiving lens (21) for receiving images with the camera lens' line-of-sight approximately parallel to the line-of-sight of the monocular components. The camera further includes random access memory (RAM) (56) and a display device (16). Processors (46, 48, 50, 52, 54) are also included within the camera for generating compressed digital video images of the received images, storing the compressed digital video images in the RAM, and displaying the received or stored images on the display device. The camera includes control mechanisms (26, 28, 30, 32) for controlling the generating, storing, and displaying of the video images.



WO 01/52531 A1

## **DIGITAL RECORD AND REPLAY BINOCULARS**

### Field of the Invention

This invention relates to binoculars, and more particularly relates to a digital video camera incorporated into a one-piece, hand-held binocular unit.

5

### Background of the Invention

For the general public, recording images as they happen has become a national pastime. Camera and video recording technology has been incorporated into many commonly known products, such as microscopes, telescopes and binoculars.

10 Recording of video images from a common set of binoculars allows the user to identify and record events at great distances. U.S. Patent No. 4,067,027 to Yamazaki discloses a binocular telescope containing a camera for photographing object scenes through the binocular lenses. Yamazaki's invention is useful for users that wish to capture still images, but fails to allow the user to capture full video images.

15 U.S. Patent No. 4,571,628 to Thornton discloses a binocular video viewing assembly having an integral object lens. The object lens observes the predetermined field of viewing and a processing assembly converts the resulting video image into electrical video signals. The electrical video signals are transferred to and stored in a remotely located video recorder. A liquid crystal display device is located within the video viewing assembly to display playback of video recorded on the remotely located  
20 video recorder. Thornton's device includes two eyepieces, like binoculars, and a single viewing lens. Although Thornton's device has the appearance and feel of binoculars, the single viewing lens generates only a single two-dimensional image, whereas binoculars allow the user to view a three-dimensional image. Also,

Thornton's device fails to be fully portable because the video recorder is remotely located and must accompany the device in order to record images.

There is a need for a completely portable combined video camera and binocular system that permits storage of a visual image. Preferably, such a device will  
5 permit three dimensional viewing of objects simultaneous to recording of those objects.

#### Summary of the Invention

In accordance with this invention, a one-piece, hand-held binocular and digital recording device is provided. The device permits simultaneous three dimensional  
10 viewing of an object through the binoculars and recording of the visual image of the object. The recording device converts the video image to digital video signals and records the digital video signals in a memory storage device within the hand-held unit. The recorded video signal may be viewed on a display that is also located on the hand-held unit.

15 More particularly described, the present invention provides a combined binocular viewing and digital recording device. The device includes binoculars having a pair of monocular components, each monocular component having an image viewing end and an image receiving end. The monocular components include a focusing mechanism to adjust images viewed through the image viewing end of the  
20 monocular components. Also, the device includes a digital video camera mounted to the binoculars. The camera includes a receiving lens for receiving images within the camera lens' line-of-sight and aligned approximately parallel to the line-of-sight of the monocular components. The camera further includes random access memory (RAM) and a display device. A processor is also included within the camera for generating  
25 compressed digital video images of the received images, storing the compressed digital video images in the RAM, and displaying the received or stored images on the display device. Finally, the camera includes control mechanisms for controlling the generating, storing, and displaying of the video images.

In accordance with other aspects of this invention, the control means includes  
30 forward and reverse viewing controls. The viewing controls preferably are multiple speed viewing controls.

In accordance with further aspects of this invention, the control means includes tint, brightness, and color controls.

In accordance with still other aspects of this invention, the camera includes a  
35 removable storage medium for storing the compressed video images.

In accordance with still further aspects of this invention, the camera further includes a data transmission mechanism for transmitting video images from the camera to a remote source.

5 In accordance with yet other aspects of this invention, the display is a liquid crystal display.

In accordance with still yet other aspects of this invention, the display is rotatable so that it may be viewed from different directions.

10 In accordance with other aspects of this invention, comprises a solar power converter for converting solar rays into electrical energy for powering the digital video camera, wherein the solar power converter is remotely located from the digital video camera and electrically connected to the digital video camera.

As will be readily appreciated from the foregoing summary, the invention provides for compactly storing and reviewing of recorded video images while viewing those images through a binocular telescope.

15 Brief Description of the Drawings

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

20 FIGURE 1 is a top view of the one piece, hand-held, combined binoculars and video recording unit incorporating the present invention;

FIGURE 2 is a sectional top view of the unit of FIGURE 1, with parts removed for detail;

25 FIGURE 3 is a sectional rear view of the unit of FIGURE 1, with parts removed for detail;

FIGURE 4 is a block diagram displaying the processing and control features of the unit of FIGURE 1;

FIGURE 5 is a top view of the unit of FIGURE 1, with an added solar power converter;

30 FIGURE 6 is a sectional rear view of the unit of FIGURE 1 with an optional display positioning feature;

FIGURE 7 is a top view of a one piece, hand-held, combined three-dimensional video image recording unit;

35 FIGURE 8 is a sectional top view of the unit of FIGURE 7 with parts removed for detail;

FIGURE 9 is a top view of the unit of FIGURE 1, with an added, remote solar power converter; and

FIGURE 10 is a top view of a three-dimensional recording unit as in FIGURE 7, with an external display added to the top.

5

Detailed Description of the Preferred Embodiment

Referring now to the drawings, in which like reference numerals represent like parts throughout the several views, FIGURE 1 sets forth a one piece, hand-held unit 10 incorporating the present invention. Briefly described, the hand-held unit 10 includes conventional binoculars 12 combined with a miniature digital video camera 15. A display, preferably a liquid crystal display (LCD) 16, is mounted on top of the binoculars 12. The hand-held unit 10 is designed to permit simultaneous three dimensional viewing of an object through the binoculars 12 and recording of the visual image of the object by the digital video camera 15. The recorded image may then be viewed on the LCD 16.

15

The binoculars 12 include two monocular components 12a and 12b positioned parallel to each other. Each monocular component 12a, 12b, includes focus adjusting eyepieces 18 at a rear end, and magnifying lenses (not shown, but well known in the art) at a forward end. The focus-adjusting eyepieces 18 and the magnifying lenses are arranged so as to permit observation of distant objects. The monocular components 12a and 12b thus provide a magnified stereoscopic or 3 D image to a user of the hand-held device 10. Thus, the binoculars 12 perform a telescopic function. It can be appreciated to one of skill in the art that various focus adjusting mechanisms may be incorporated with the monocular components 12a, 12b.

20

The digital video camera 15 is attached between the top inner portion of the monocular components 12a and 12b and provides lateral support and separation of the monocular components. The digital video camera 15 includes a video camera lens 21 at the forward end of the digital video camera 15. The digital video camera 15 may be automatically focusing, such as is known in the art, or may have its focusing mechanism mechanically tied to the focus of the binoculars 12, thus allowing a user to zoom in on a specific action of interest. Top longitudinal edges 22, 24 (FIGURE 3) of the digital video camera 15 slope downwardly away from the top of the digital video camera 15 to the upper portion of the monocular components 12a, 12b. Located at the rear end of the left downwardly sloping edge 22, collocated with the left monocular element 12a, are a forward/play button 26 and a reverse/play button

30



28. On the rear end of the right downwardly sloping edge, collocated with the right monocular element 12b, is a record button 30.

The LCD 16 is positioned on the forward half of the top surface of the digital video camera 15. The LCD 16 is preferably mounted flush with the top surface of the digital video camera 15. However, the LCD may also be a flip up variety 17 (FIGURE 6), or may be located in any convenient location on the hand-held unit 10.

As shown on FIGURE 2, the rear vertical edge of the digital video camera 15 includes an on/off control 32, a brightness control 34, a color control 36 and a tint control 38. Each of the controls 32, 34, 36, 38 are used to adjust and set the LCD 16 in a manner known in the art. Located below the controls 32, 34, 36, 38 is an opening to a personal computer (PC) Card receiving port 40, shown in FIGURE 3, for receiving a PC Card 42 within the digital video camera 15.

A printed circuit board 44 (FIGURE 2) is located internally along the length of the digital video camera 15. The printed circuit board 44 includes a processing system, which has a microprocessor 46, an image processor 48, a signal processor 50, a display driver 52, ROM video logic 54, and video cache RAM 56.

A power unit, such as a rechargeable battery 58 (FIGURE 3), is inserted beneath the PC Card receiving port 40. Optional power supplies, such as a car adapter (not shown, but well known in the art), an AC power converter (not shown, but well known in the art), or solar (described below), may also be used.

The operation of the hand-held unit 10 can be understood with reference to the above description. A user may utilize the binoculars 12 in a traditional manner, i.e., the binoculars may be pointed at an object and the eyepieces 18 may be manipulated so as to draw the object into focus. This feature does not require a power supply such as the battery 58.

To record an event targeted by the binoculars 12, the user depresses the record button 30, causing the digital video camera 15 to process and store images. The video camera lens 21 receives images and relays the images to the image processor 48, which in turn processes the images and forwards the images to the signal processor 50. The signal processor 50 digitizes the video images processed by the image processor 40 and stores the digitized video images in the video cache RAM 56. Optionally, the digitized video images may be stored on the PC card 42. The destination for the digitized video images of either the video cache RAM 56 or the PC card 42 is determined according to control programs stored in the microprocessor 46 and associated programs in the ROM Video Logic 54. The digitized video images are

preferably stored in the video cache RAM 56 and/or the PC card 42 using high speed image compression algorithms that provide maximum performance and storage capability.

5 The PC card 42 provides retaining and transferring of recorded images for future review on the digital video camera 15 or other PC card enabled devices such as a computer or a television. In addition, PC cards with PCMCIA standards support networking and telecommunications may be utilized for remote storing and viewing of recorded video images. It can be appreciated to one of skill in the art that the PC card 42 could be replaced by more conventional RAM if desired.

10 Depression of the forward/play button 26 initiates the viewing of stored images from the video cache RAM 56 or the PC card 42. A decompression algorithm is utilized to restructure the compressed, digitized video images. The retrieved images are viewed on the LCD 16. Alternatively, the reverse button 28 may be depressed for playing stored images in reverse. The forward/play and reverse buttons 15 26, 28 are preferably tri-state such that each press of the buttons alters the replay flow from normal motion to slow motion to frozen motion. It can be appreciated by one of skill in the art that the buttons 26, 28 can perform multiple functions relating to video viewing, such as high speed scanning. A single play control button could be used in place of the forward/play and reverse buttons 26, 28 for performing similar functions.

20 FIGURE 4 illustrates a block diagram of the process and features control of the present invention. The processing system receives control signals from the buttons 26, 28, 30, 32 and DC power from the battery 58. If the processing system receives a "record" control signal from the record button 30, the processing system delivers recorded images to memory (the video cache RAM 56 or the PC card 42) for storage. If a "playback" control signal is delivered by the forward/play button 26 to the processing system, the processing system retrieves images from the memory (the video cache RAM 56 or the PC card 42) and sends the images to the display (the LCD 16). The controls 32, 34, 36, 38 and control circuitry (not shown, but well known in the art) provide a user control of image processing for the display of the 25 processed images.

30 FIGURE 5 illustrates an alternate feature for powering the unit 10. Located on the top of the video camera 15, adjacent to the LCD 16, is a solar power converter 59, such as is known in the art. The solar power converter 59 converts solar energy to DC electric current to power the digital video camera 15 and charge the rechargeable battery 58. The solar power converter 59 may be remotely connected,

as shown by solar converter 59a in FIGURE 9, either stand alone or attachable to an object surface that receives a considerable amount of solar rays, such as a hat worn on a user's head, an umbrella, a backpack, etc.

FIGURE 6 illustrates a LCD 17 that is rotatable on the top of the digital video camera 15, while still maintaining an electrical connection to the processing system. Preferably, the LCD 17 rotates about the rear edge of the LCD 17, the edge closest to the eyepieces 18, to a vertical position for optimal viewing by the user. Rotation of the LCD 17 through any number of angles up to approximately 180° from a flush mounted position allows viewing of images without rotation of the unit 10. This feature is important if moving the unit 10 to view displayed images would cause the loss of an image targeted by the user.

FIGURES 7, 8 and 10 illustrate a three-dimensional image recording and playback unit 60 of the present invention. The unit 60 includes a central housing 61 mounted at its front left bottom corner to the top of a left digital video camera 62a and at its front right bottom corner to the top of a right video camera 62a. The unit 60 also includes eye viewing members 64a, 64b, each mounted under the rear corners of the central housing 61. Each video camera 62a, 62b includes a lens 21a, 21b, an image processor 48a, 48b and a signal processor 50a, 50b. The camera lenses 62a, 62b, the image processors 48a, 48b and the signal processors 50a, 50b generate two sets of digital video images, thus replacing the single lens and corresponding processors of the video camera 15, described above.

The eye viewing members 64a, 64b include display devices 66a, 66b and drivers 68a, 68b. The other processing, controlling and storing components within the housing are similar to those found in the previous embodiment. However, the control logic in unit 60 must be programmed to properly store the two sets of generated digital video images and properly retrieve and process the two sets of stored images or generated two sets of digital images for display on the display devices 66a, 66b. This embodiment can also perform recording from only one camera, thus allowing for storage of a greater number of images. The displaying of the two sets of generated digital video images is done stereoscopically, holographically or by another commonly known two-display three-dimensional viewing technique. When viewed through the eye viewing members 64, a user sees a three-dimensional image, similar to what the user sees through conventional binoculars.



Unit 60 further includes a zoom control button 70. As shown in FIGURE 8, the zoom control button 70 includes a zoom portion 70a and an unzoom portion 70b. Depressing the zoom portion 70a of the zoom button 70 causes the camera lenses 62a, 62b to increase focal length, thus zooming in on the scene being viewed.

5 Depressing the unzoom portion 70b of the zoom button 70 causes focal length of the camera lenses 62a, 62b to decrease, thus expanding on the scene being viewed. Focus is maintained by an auto-focus feature.

The processing system may be a general purpose video processing system of a type well known to those skilled in the art. Furthermore, the microprocessor 46 and

10 the processing system may be programmed by a programmer of ordinary skill to accept the inputs, perform the functions, and provide the outputs required for operation of the present invention, given the description contained herein.

The hand-held unit 10 provides a variety of features and advantages not offered in the prior art. The hand-held unit 10 may be used similarly to typical

15 binoculars, without using the digital video camera 15. The digital video camera 15 provides recording and playback of a viewed event. All of the features of the binoculars 12 and the digital video camera 15 are contained within the single, hand-held unit 10, thus providing a user with a completely portable system.

Although not shown, it can be contemplated that the camera portion may be

20 remotely located from the other components of the unit with conventional non-wire data transmission techniques performing two-way data communication between the camera and the unit. The camera portion can transmit video images and the unit can transmit controlling signals, such as motion signals directing motorized motion control of the camera. Locating the camera portion in hazardous environments greatly

25 reduces the risks to the user.

Another feature not shown is a coupling feature that allows the hand-held unit to connect to various like devices, such as computers, televisions, etc. The coupling feature provides for the data transmission, such as downloading of stored images, powering the unit, recharging of the unit's battery, etc.

30 While the embodiments of the invention have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention, as defined in the appended claims. For example, a central computer can control multiple units to automatically record an event from multiple positions. In another example, image recording can be performed at various

35 resolutions, black and white or color, etc. as determined by manual or automatic

control. More images can be stored when recording is performed at lower resolutions.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A hand-held unit comprising:  
binoculars having a pair of monocular components, each component having an image viewing end and an image receiving end and defining a line-of-sight; and  
a digital video camera mounted to the binoculars with the camera lens' line-of-sight approximately parallel to the lines-of-sight of the monocular components, the digital video camera comprising:  
a receiving lens for receiving images;  
a digital memory storage unit integral with the hand-held unit;  
a display device;  
a processing system for generating compressed digital video images of said received images, storing the compressed digital video images in the memory storage unit and displaying at least one of the received or stored images on the display device; and  
means for controlling the generating, storing and displaying of the video images.
2. The device of Claim 1, wherein the monocular components include a focus mechanism for focusing images viewed through the image viewing end of the monocular components
3. The device of Claim 1, wherein the control means includes forward and reverse video viewing controls.
4. The device of Claim 3, wherein the forward and reverse viewing controls are multi-speed video viewing controls.
5. The device of Claim 1, wherein the means for controlling includes a zoom control.
6. The device of Claim 1, wherein the camera further comprises a removable memory storage unit for storing the compressed video images.
7. The device of Claim 6, wherein the removable memory storage unit is a PC card.

8. The device of Claim 1, wherein the camera further comprises means for transmitting data video images off the camera.

9. The device of Claim 1, wherein the display is a liquid crystal display.

10. The device of Claim 1, wherein the memory storage unit is random access memory (RAM).

11. The device of Claim 1, wherein the display is remote of the image viewing end of the binoculars.

12. The device of Claim 2, wherein the focusing mechanism is an auto-focus mechanism for focusing on targeted images.

13. The device of Claim 2, wherein the focusing mechanism is a manual focus mechanism for focusing on targeted images.

14. The device of Claim 1, wherein the display is rotatably attached to the digital video camera.

15. The device of Claim 1, wherein the digital video camera further comprises a solar power converter for converting solar rays into electrical energy for powering the digital video camera.

16. The device of Claim 15, wherein the solar power converter is remotely located from the digital video camera and electrically connected to the digital video camera.

17. A hand-held unit comprising:

binoculars having a pair of monocular components, each component having an image viewing end and an image receiving end and defining a line-of-sight; and

a digital video camera mounted to the binoculars with the camera lens' line-of-sight approximately parallel to the lines-of-sight of the monocular components, the digital video camera comprising:

a receiving lens for receiving images;

a removable digital memory storage unit;

a display device;

a processing system for generating compressed digital video images of said received images, storing the compressed digital video images in the removable digital memory storage unit and displaying at least one of the received or stored images on the display device; and

means for controlling the generating, storing and displaying of the video images.

18. The device of Claim 17, wherein the removable memory storage unit is removable from a location internal to the hand-held unit.

19. The device of Claim 18, wherein the removable memory storage unit is a PC card.

20. A hand-held unit comprising:

binoculars having a pair of monocular components, each component having an image viewing end and an image receiving end and defining a line-of-sight; and

a digital video camera mounted to the binoculars with the camera lens' line-of-sight approximately parallel to the lines-of-sight of the monocular components, the digital video camera comprising:

a receiving lens for receiving images;

a digital memory storage unit integral with the hand-held unit;

a display device;

a processing system for generating compressed digital video images of said received images, storing the compressed digital video images in the memory storage unit and displaying at least one of the received or stored images on the display device;

means for controlling the generating, storing and displaying of the video images; and

a solar power converter for converting solar rays into electrical energy for powering the components of the digital video camera.

21. The device of Claim 20, wherein the solar power converter is remotely located from the digital video camera and electrically connected to the digital video camera.

22. A hand-held unit comprising:



binoculars having a pair of monocular components, each component having an image viewing end and an image receiving end and defining a line-of-sight;

a display device remote of the image viewing end of the binoculars; and

a digital video camera mounted to the binoculars with the camera lens' line-of-sight approximately parallel to the lines-of-sight of the monocular components, the digital video camera comprising:

a receiving lens for receiving images;

a digital memory storage unit integral with the hand-held unit;

a processing system for generating compressed digital video images of said received images, storing the compressed digital video images in the memory storage unit and displaying at least one of the received or stored images on the display device; and

means for controlling the generating, storing and displaying of the video images. a display device.

23. A hand-held unit comprising:

a central housing portion;

first and second eyepiece viewing ports with internal displays; and

first and second digital video cameras with processors mounted to the central housing portion of the unit for receiving images and for generating first and second sets of digital video images of said received images, wherein the central housing portion comprises:

a memory storage unit;

a processing system for compressing the generated first and second sets of digital video images, storing the compressed digital video images in the memory storage unit and displaying the first and second sets of digital video images on the internal displays; and

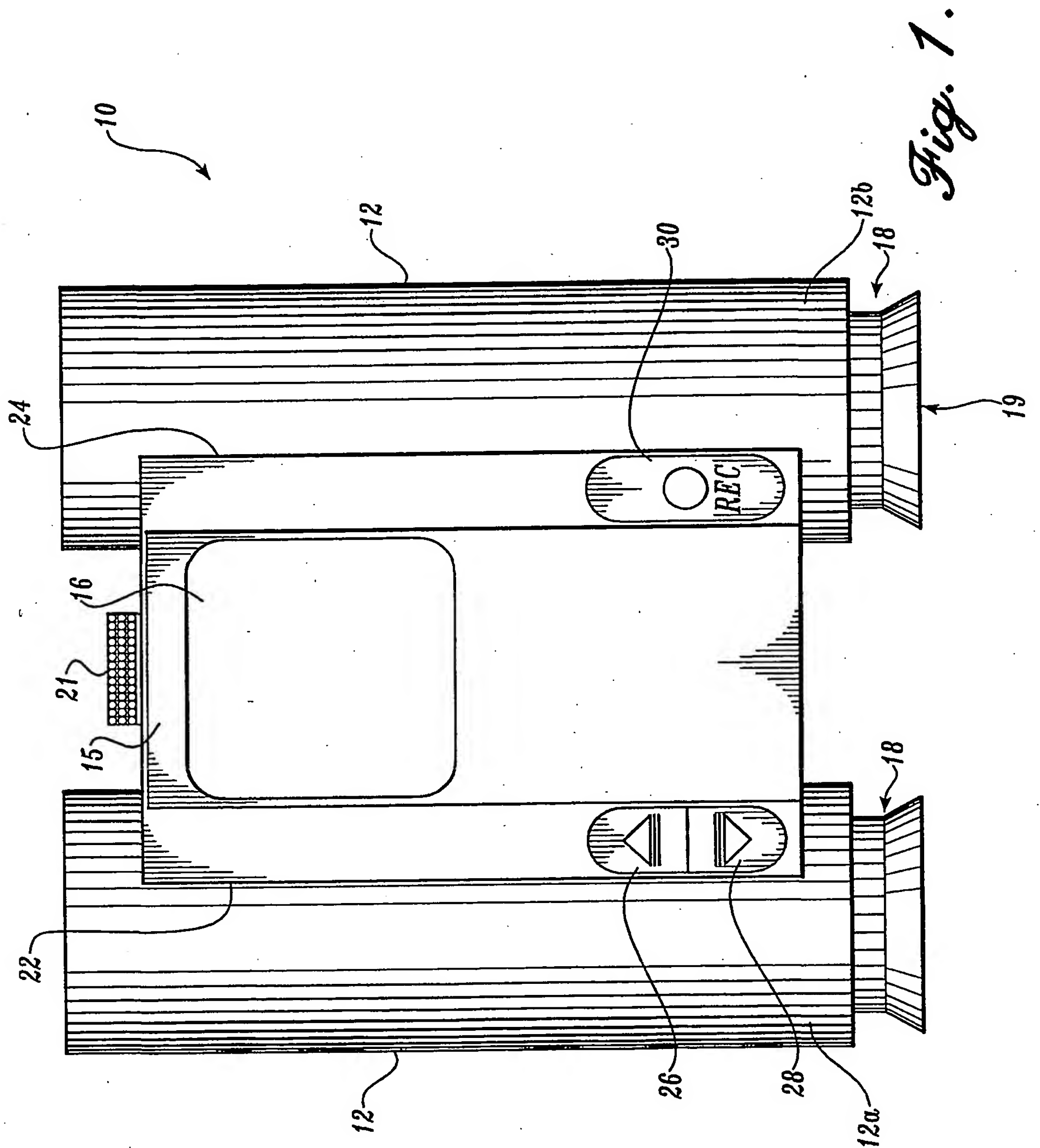
means for controlling the generating, storing and displaying of the video images.

24. The device of Claim 23, wherein the first set of digital video images generated by the first digital video camera are displayed on the display within the first eyepiece viewing port and the second set of digital video images generated by the second digital video camera are displayed on the display within the second eyepiece viewing port.

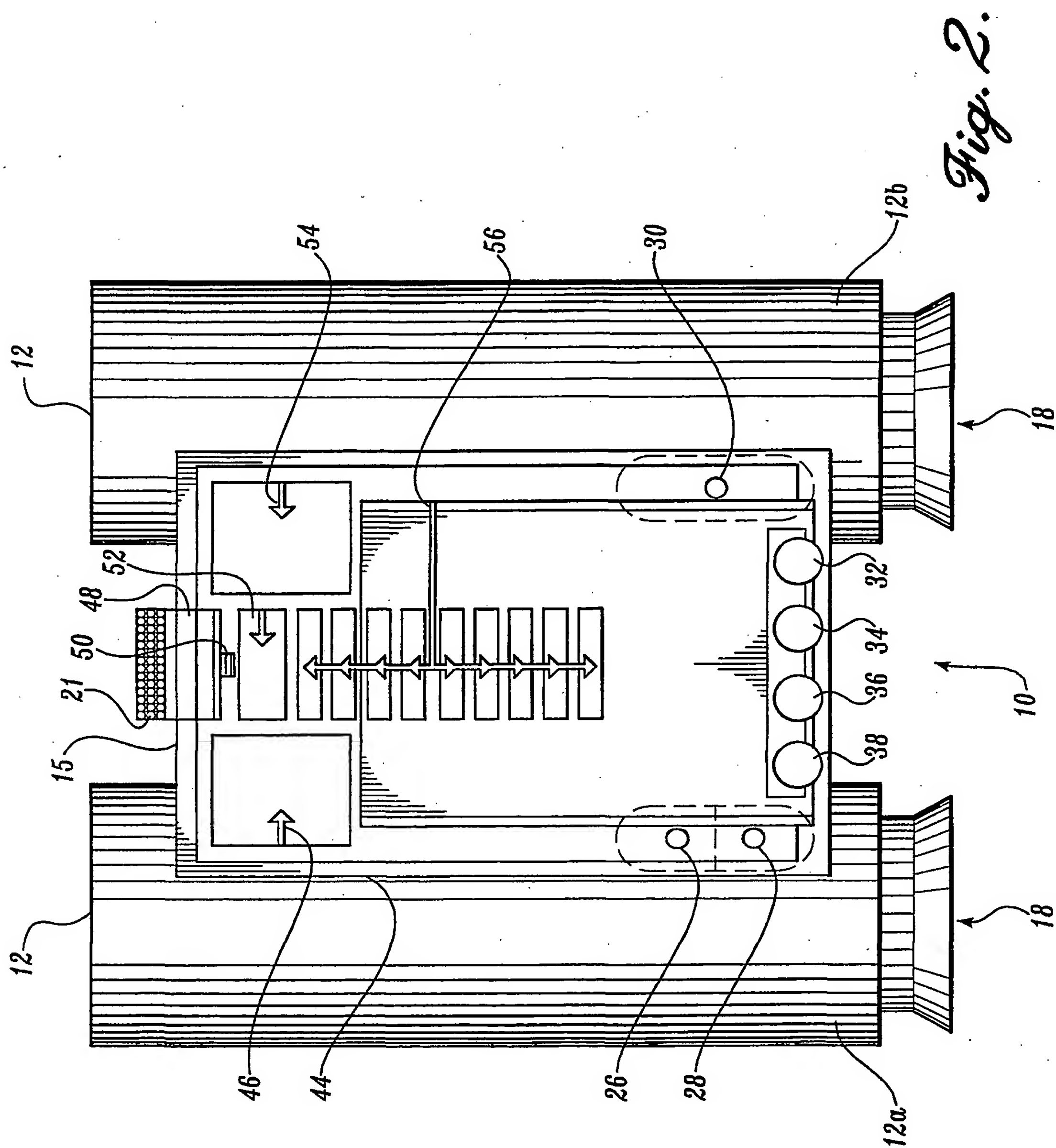
25. The device of Claim 23, wherein the means for controlling includes a zoom control.

26. The device of Claim 23, further comprising an external display remote of the image viewing end of the binoculars.

1/10



2/10



3/10

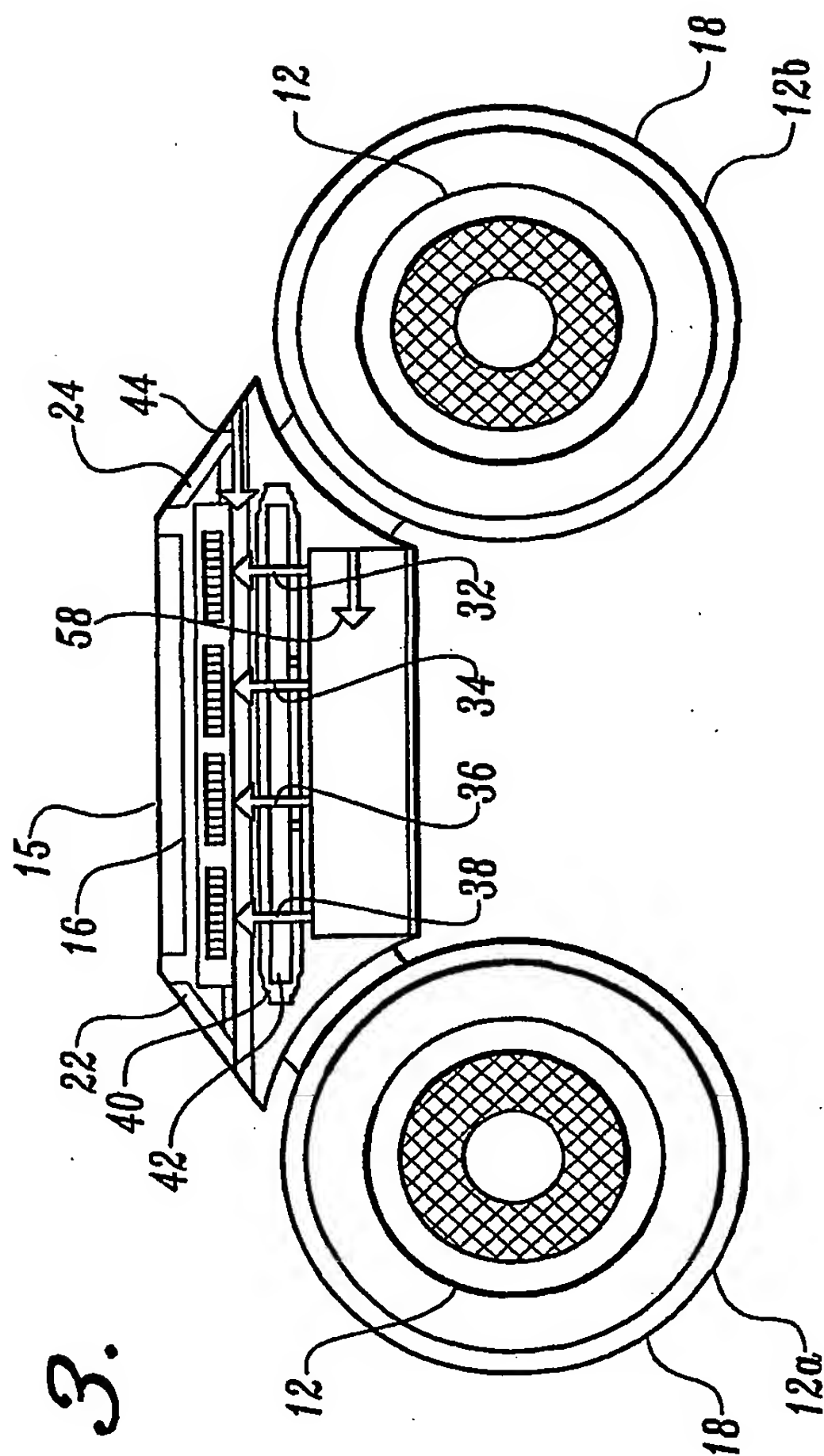
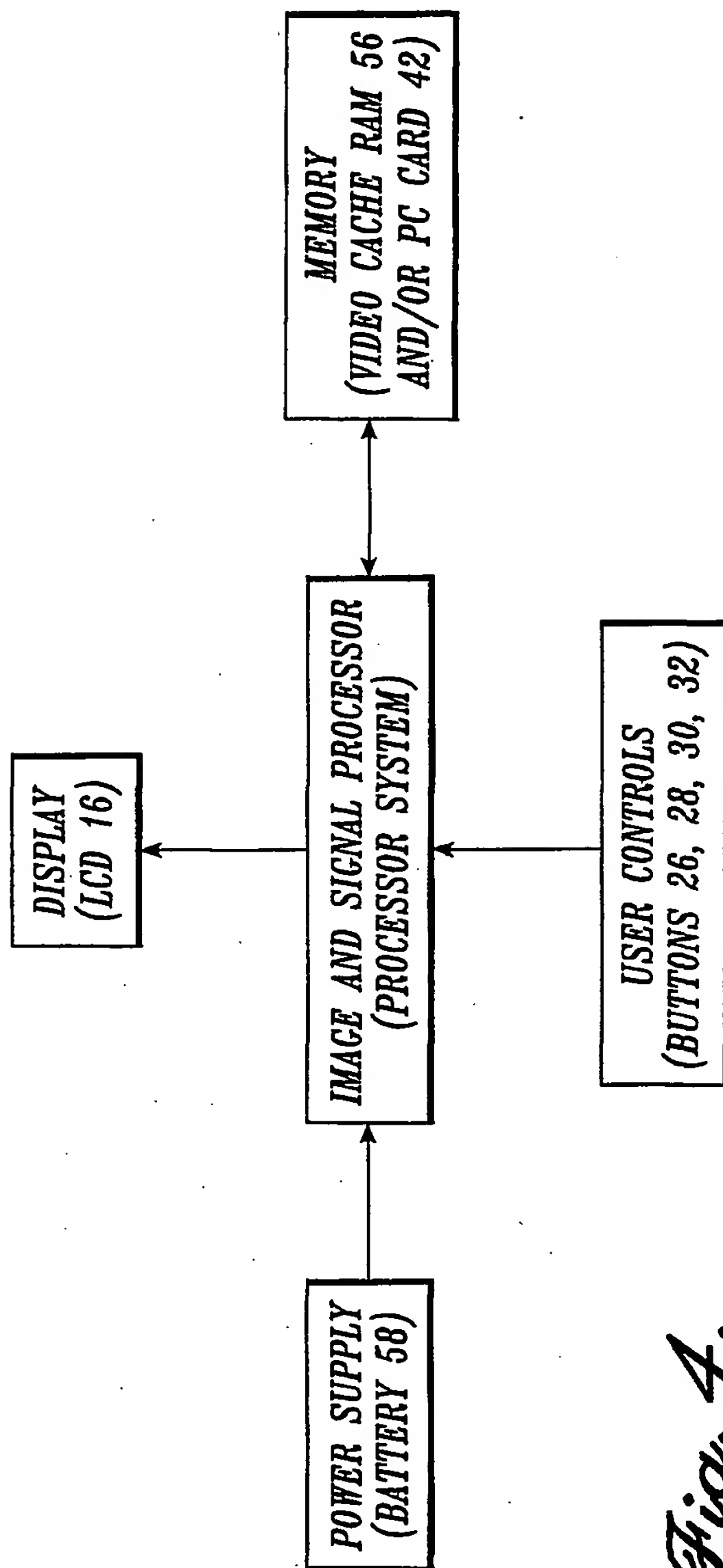


Fig. 3.



4/10



*Fig. 4.*

5/10

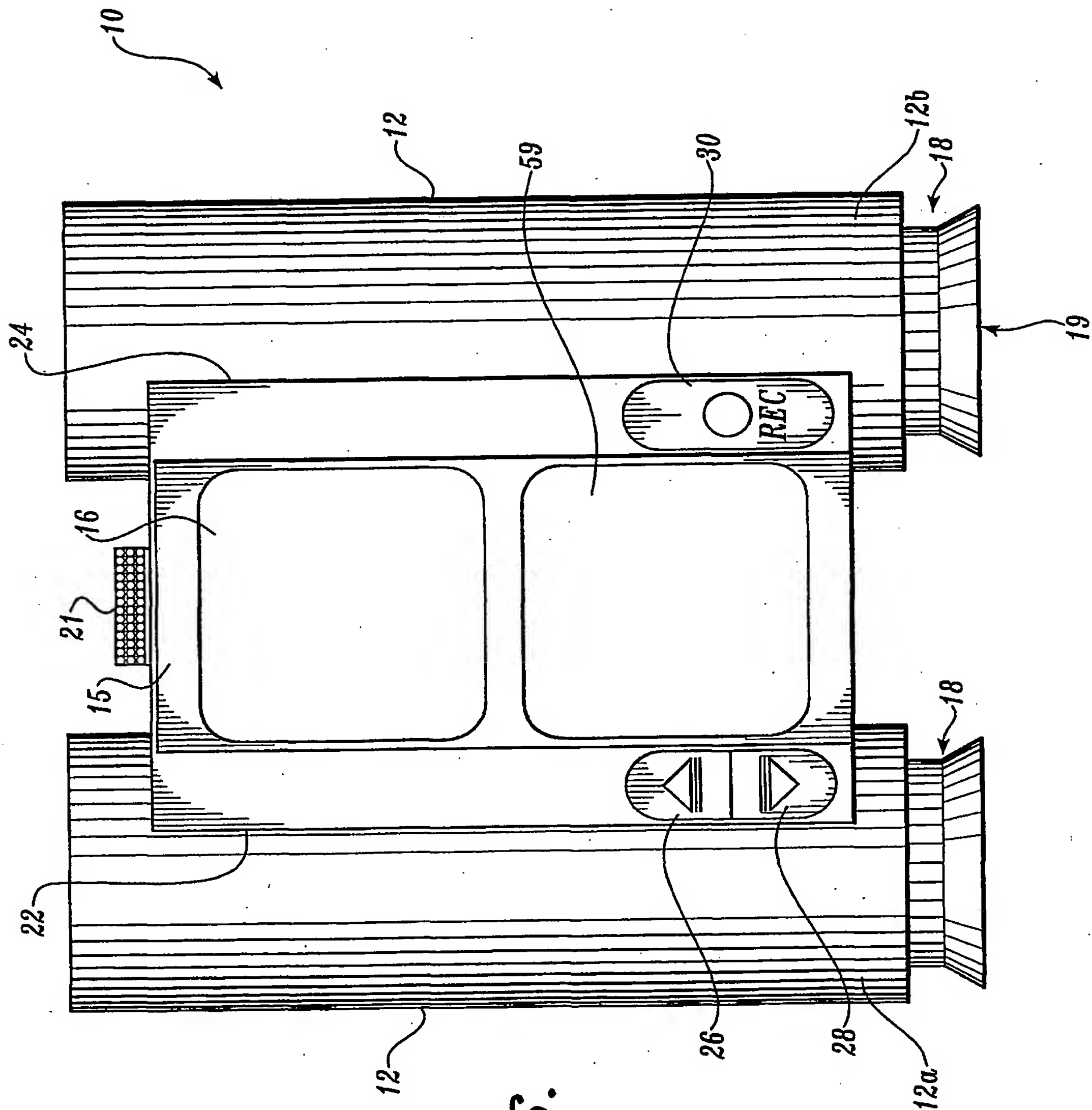
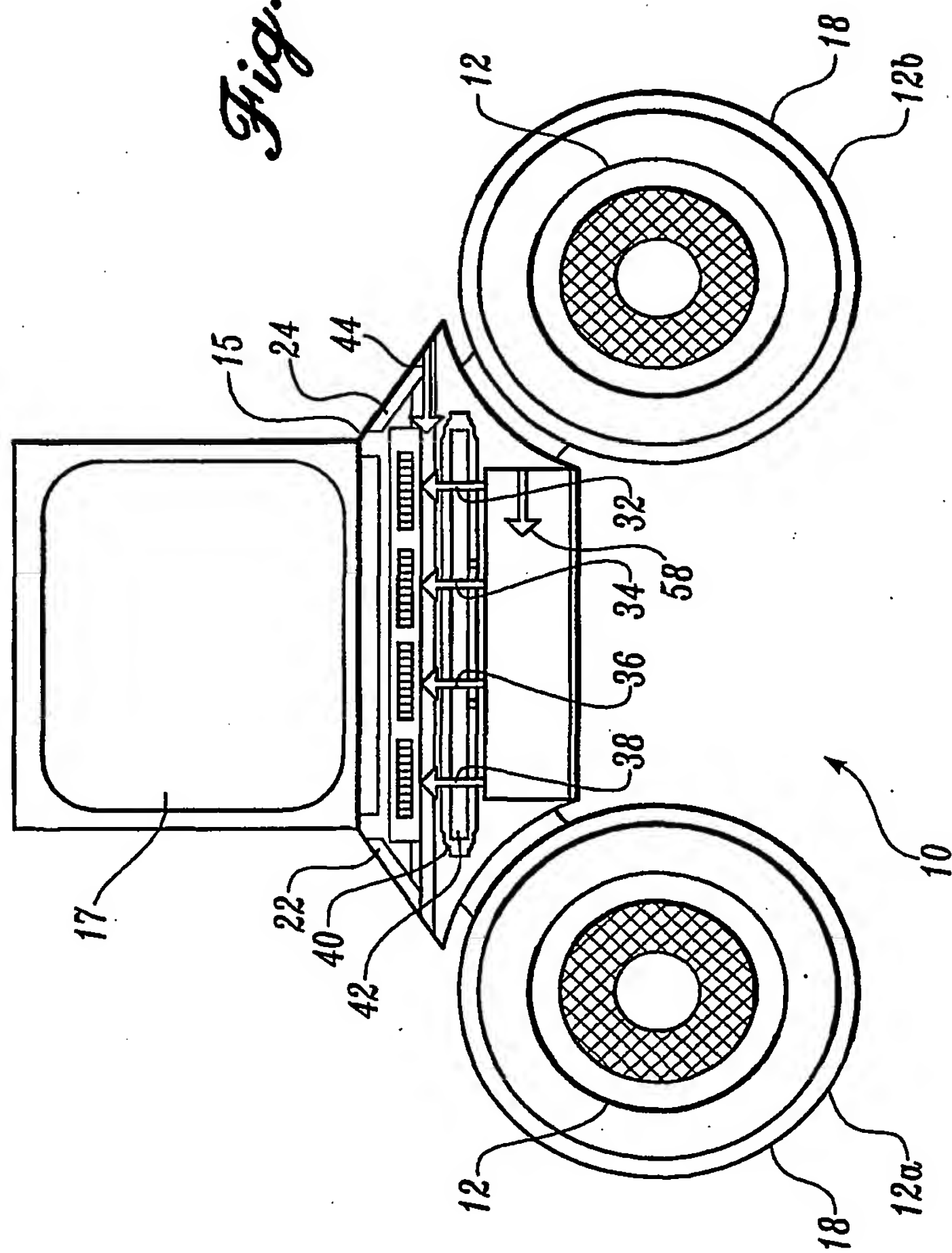


Fig. 6.

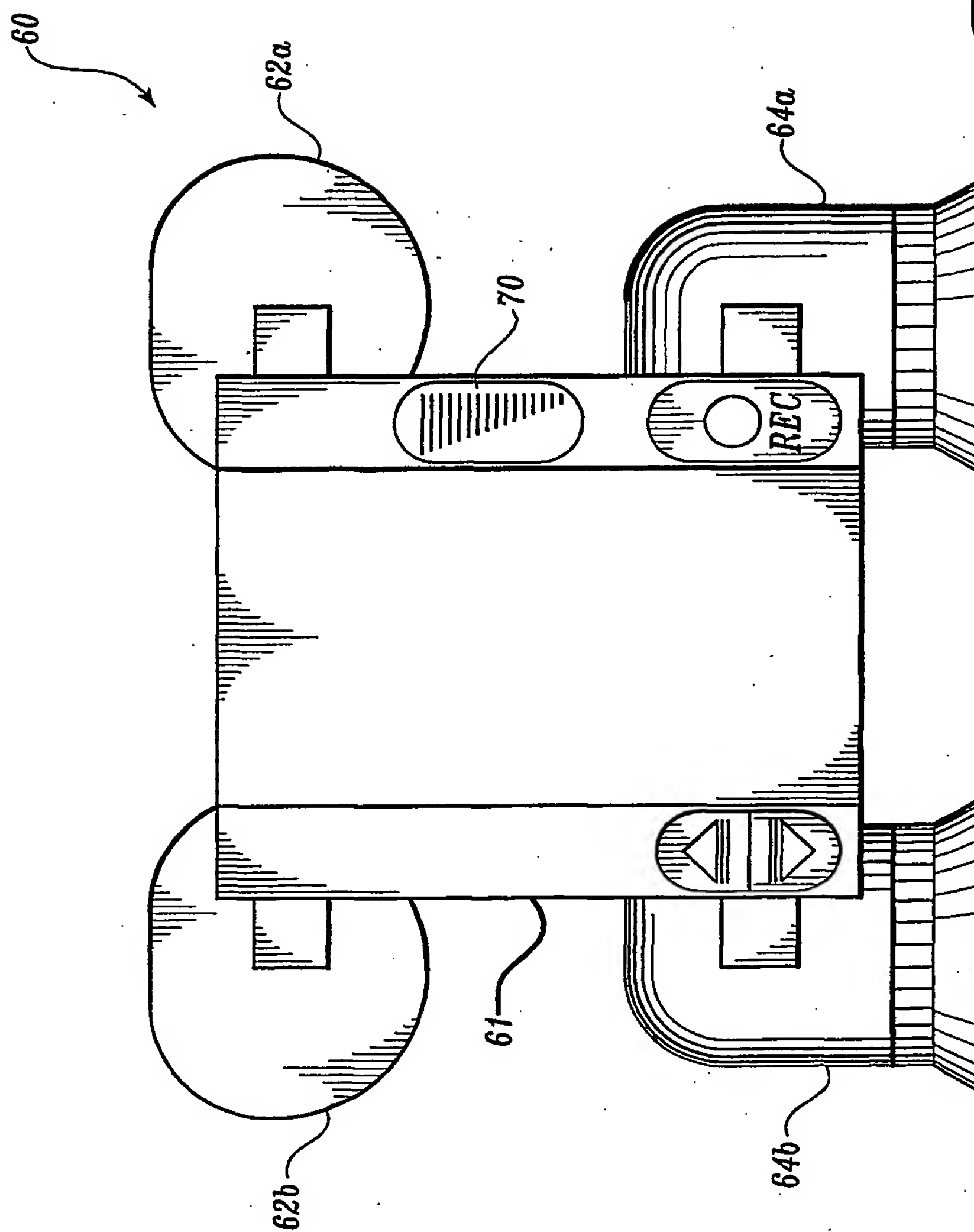
6/10

Fig. 6.



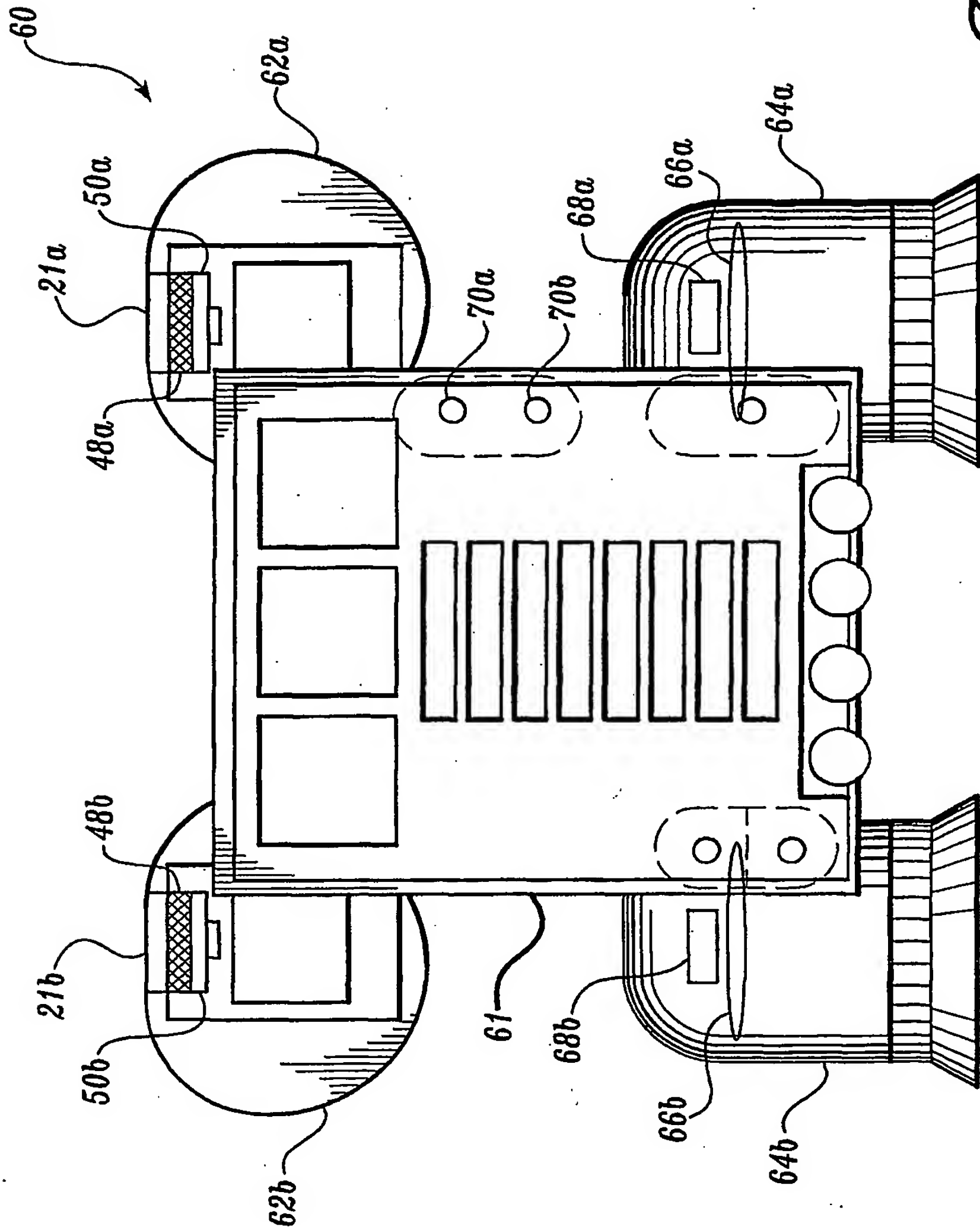
7/10

*Fig. 7.*

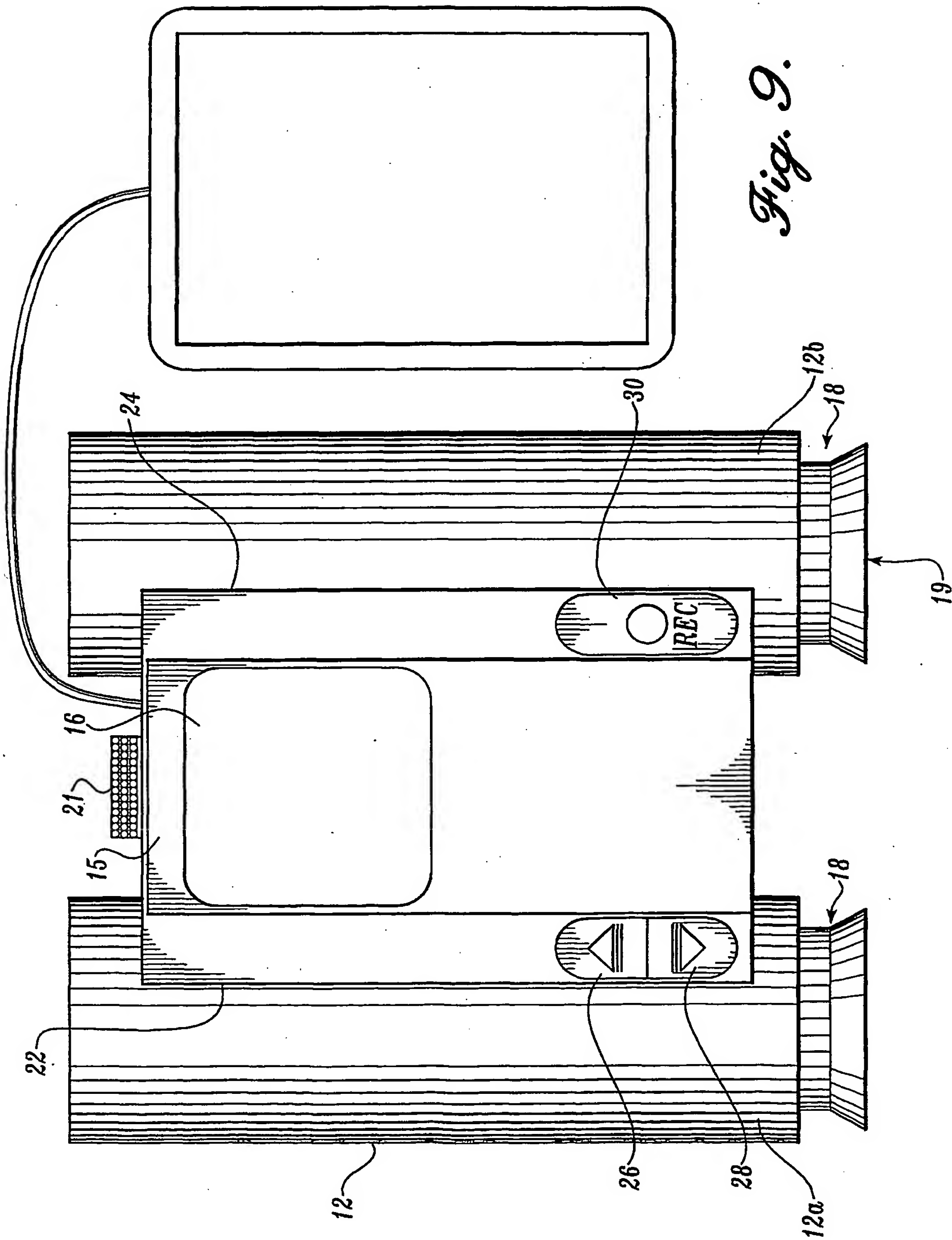


8/10

Fig. 8.







10/10

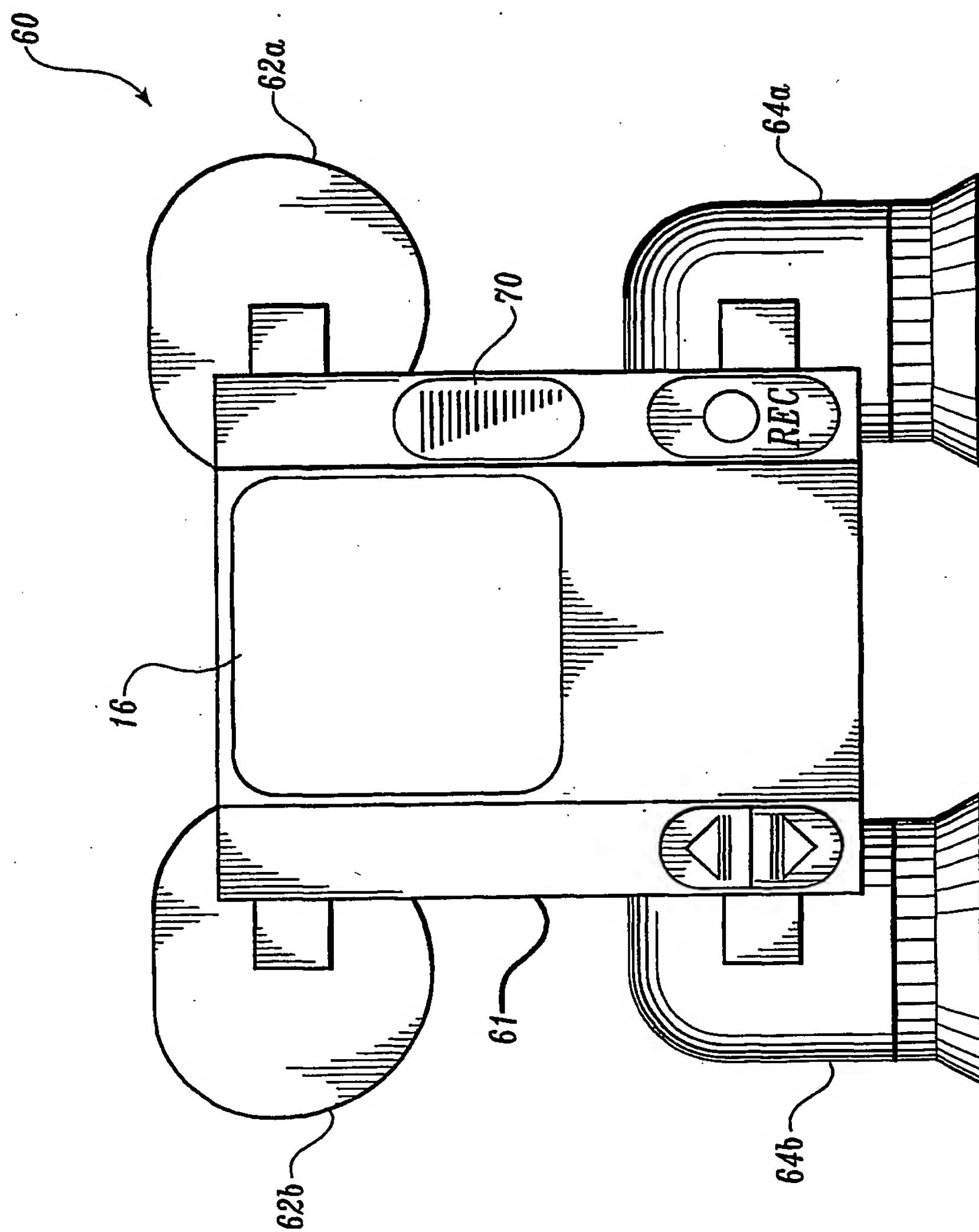


Fig. 10.

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 H04N5/77 H04N5/907 H04N13/00 G02B13/18

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 06870 A (DAVID THURLOW) 11 February 1999 (1999-02-11)  page 1, line 22 -page 6, line 19; figures 1-3	1,3,4, 9-11,17, 23,24,26
Y		2,6-8, 12,13, 15,18, 19,22
A		5,14,16, 25

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 September 2000

Date of mailing of the international search report

19/09/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Dudley, C

# INTERNATIONAL SEARCH REPORT

Inter al Application No  
PCT/US 00/00394

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 963 369 A (STEINTHAL ET AL) 5 October 1999 (1999-10-05)  column 3, line 11 -column 5, line 28; figures 1-5	1,3,4, 8-11,17, 22-24,26
Y		2,12,13, 20
A		6,7,21, 25
Y	US 4 067 027 A (YAMAZAKI) 3 January 1978 (1978-01-03) cited in the application column 2, line 4 -column 3, line 31; figures 1-4	2,12,13
Y	US 5 528 293 A (MIKIO WATANABE) 18 June 1996 (1996-06-18) column 4, line 53 -column 5, line 24; figure 1	6-8,18, 19,22
Y	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 12, 26 December 1996 (1996-12-26) & JP 08 211468 A (CANON INC), 20 August 1996 (1996-08-20) abstract	15,20
A		16,21

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/00394

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9906870	A	11-02-1999	NONE	
US 5963369	A	05-10-1999	NONE	
US 4067027	A	03-01-1978	NONE	
US 5528293	A	18-06-1996	JP 7274108 A	20-10-1995
JP 08211468	A	20-08-1996	US 6096969 A	01-08-2000